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SIMBIOS Project 2001 Annual Report

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Chapter 7

Merging Ocean Color Data From Multiple Missions

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7.1 INTRODUCTION

We propose to investigate, develop, and test algorithms for merging ocean color data from multiple missions. We seek general algorithms that are applicable to any retrieved Level-3 (derived geophysical products mapped to an Earth grid) ocean color data products, and that maximize the amount of information available in the combination of data from multiple missions. Most importantly, we will investigate merging methods that produce the most complete coverage in the smallest amount of time, nominally, global daily coverage. We will emphasize 4 primary methods: 1) averaging, 2) subjective analysis, 3) blending, and 4) statistical (optimal) interpolation. We will also assess the ability to produce fuller coverage in larger time increments, including 4-day, 8-day (weekly), monthly, and seasonal. Secondarily, we will investigate the ability of the missions to produce coverage at different times of day, for diel variability and dynamical evaluations, and develop algorithms to produce this information, again on as full a spatial coverage as possible. We intend to develop methods that are not mission-specific, but take advantage of the unique characteristics of the missions as much as possible. However, given the peculiarities of sensor design and performance, and mission characteristics, we acknowledge that individual merging methods may be required to take full advantage of the unique characteristics of the missions as much as possible, and produce the highest quality data set.

7.2 RESEARCH ACTIVITIES

Work has focused on analysis, development, and testing of candidate merger algorithms. We began investigating four possible approaches for merging ocean color satellite data: (1) simple splicing/averaging, where data from two or more satellites are averaged where they coexist at grid points, and use of a single satellite in gaps where only one exists; (2) subjective analysis, where specific dependences and deficiencies are identified using knowledge about sensor environmental conditions and co-located observations are merged using different weighting functions for the sensors; (3) the Conditional Relaxation Analysis Method (CRAM), where the best data are selected as interior boundary conditions into a merged set using Poisson's equation; and (4) optimal interpolation, where merging occurs by weighting individual sensor data to minimize spatial covariance function. The latter two algorithms were developed under separate funding. The algorithms have been characterized and implemented in software; their capabilities and limitations are known, as well as their ability to be modified. The application of algorithms and potential modifications depends on a characterization of the merged data sets.

Significant progress has been made on each of these techniques with the majority of analysis this year focusing on blending. The blended analysis has traditionally been applied to merging satellite and in situ data. Also known as the Conditional Relaxation Analysis Method (CRAM), this analysis assumes that in situ data are valid and uses these data directly in the final product. To blend multiple satellite ocean color data sets, one sensor's data would replace the role of the in situ data as the internal boundary condition (IBC). In January 2001, initial results of the application of blended analysis using SeaWiFS and early MODIS data were presented at the SIMBIOS Science Team Meeting in Greenbelt, Maryland. SeaWiFS chlorophyll data were used as the IBC. The radiometric calibration of the MODIS data was insufficient for scientific use but served the purpose of algorithm investigation. For this preliminary analysis, six weeks of daily Level-3 globally mapped MODIS and SeaWiFS data were obtained from the Goddard DAAC. Routines were written in IDL (Interactive Data Language) to extract the MODIS and SeaWiFS chlorophyll images from their native HDF (Hierarchical Data Format), to scale and orient the images properly, to retrieve the accompanying quality flags for MODIS, and to save the resulting images as FORTRAN binary. Global equal-area mapped MODIS data is available at 4-km, 36-km, and 1-degree; SeaWiFS standard mapped images are at 9-km resolution. Both are available daily, weekly, monthly and yearly. For testing, the blend code was modified to run at different spatial resolutions and several weeks of blended results were obtained using daily 36-km and 1-degree data. Running the blend code at a higher spatial resolution on a global data set is possible, but time consuming.